

REPORT DOCUMENTATION PAGE

Form Approved
OMB NO. 0704-0188

Public Reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comment regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.			
1. AGENCY USE ONLY (Leave Blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED	
	12/20/02	01 Jun 96 31 May 02 2/28/02-5/31/02	
4. TITLE AND SUBTITLE Development of a Center for Advanced Mold/Mask Processes and Applications For the Miniaturization Technologies.		5. FUNDING NUMBERS DAAGHD4-96-1-0200	
6. AUTHOR(S) Kody Varahramyan, Philip Coane, Louisiana Tech University Mahmoud Hosseini, Shin-Shiu Chen, Grambling State University		8. PERFORMING ORGANIZATION REPORT NUMBER 35801-5-RT-RSP	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Institute for Micromanufacturing La Tech University 911 Hergot Avenue P.O. Box 10137 Ruston, LA 71272		10. SPONSORING / MONITORING AGENCY REPORT NUMBER 12 a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.	
11. SUPPLEMENTARY NOTES The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other documentation.			
12 b. DISTRIBUTION CODE			
13. ABSTRACT (Maximum 200 words) <p>This constitutes the final report for this project during its final no-cost extension period. This period of the grant marked the consolidation of several individual projects into mature research areas, the application of the major equipment purchased by the grant toward many of the research thrusts and the purchase of additional equipment. Specifically, the additional equipment purchased with support from the grant are an Atomic Force Microscope (AFM) and a Small Scale Electroplating Station. Human resource training in microtechnologies at Grambling State University has also been expanded in this grant period.</p>			
14. SUBJECT TERMS		15. NUMBER OF PAGES 3	
		16. PRICE CODE	
17. SECURITY CLASSIFICATION OR REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION ON THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL
NSN 7540-01-280-5500			

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

20030403 053

Executive Summary

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Three Dimensional Mold Making Capabilities

In keeping with the primary thrust of this research effort, which is to develop novel methods for the fabrication of true three dimensional micro- and nano structures, an Atomic Force Microscope (AFM) and a small scale plating station were purchased. The AFM has been providing the capability for measurement and characterization of micro- and nano structures, as stemming from the grant research areas and projects. Moreover, the ability to electroplate a three-dimensionally varying geometry using multi-layer methods allows the realization of electroplated microstructures in an inexpensive and manufacturable fashion. The ultimate objective is to use both electro and electroless deposition techniques to fabricate molds and thereby demonstrate mass production of microstructures with an arbitrary geometric cross-section. In addition to mold fabrication, electrodeposited microstructures can be released from the substrate (using sacrificial layer technology) to yield unconstrained micro components that can be positioned in a micro assembly using post-processing techniques.

The new plating station offers significant advantages over the existing in-house fabricated stations. Real-time monitoring and precise control over critical parameters, which is necessary in order to achieve uniform deposition in high aspect ratio microstructures, is provided. The ability to electroplate in both acidic and alkaline solutions as well as certain solvent-based solutions is also an important attribute of this system. In addition to the more conventional direct current plating, enhancements include pulse current and pulse reverse current plating capabilities and a proprietary rotating disc electrode to ensure greater control of the deposition process making it possible to produce non-porous and uniform deposits over a 6" diameter substrate.

Human Resource Development

Human resource development was originally envisioned to be mainly at the technician and undergraduate level, and developed principally by Grambling State University. Parts of the human resource development effort have been continued over the extension period of this grant.

A microtechnology curriculum was developed and initiated in the Manufacturing Engineering Technology program, under the direction of Dr. Edward Harrison. Students in the Manufacturing Engineering Technology program have taken the course in microtechnology, which has consisted of classroom education and hands-on laboratory training with a set of machinery that is ideally suited for an introduction to micromachining. Educational modules in the microtechnologies have been developed and recorded on tape. The topics included:

Overview of MEMS

Safety

Metrology

Vibration Isolation

Metrology and Testing

Precision Micromachining: a. Microdrilling, b. Micromilling, c. Laser Machining

Grambling has also been the focal point of the local outreach and the distance-learning network that includes Northwest Louisiana Technical College and Ruston Technical College. The human resources outreach also included local high schools.